

Modeling freight consolidation from the perspective of transportation carriers

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Abstract

This paper addresses an extensive study of the operational planning of horizontal carrier cooperations. Based on current collaboration literature, a distinction has been made between three main research streams: order sharing, capacity sharing and profit / cost allocation. First, existing solution methods for each of these cooperation approaches are reviewed. Second, on the basis of possible study voids, proposals are made to expand the scientific knowledge base on joint route planning through vehicle routing, various capacity sharing techniques and allocation methods making use of game theory.

Keywords: Collaborative logistics, Carriers, Operational planning approaches

Severe competition in global markets and the heightened expectations of customers have caused profit margins of transport companies to shrink. In order to survive under the ever increasing pressure to operate more efficiently, they are obliged to adopt a collaborative focus. Companies operating at the same level of the supply chain may cooperate horizontally to increase their productivity, improve their service level and enhance their market position [1] [2]. This paper studies collaborative logistics from the carrier perspective. The purpose of horizontal cooperation between carriers is to create a more efficient transport planning, to extend their resource portfolio and reinforce their market position.

Existing scientific literature on the operational planning of carrier collaboration may be divided into three research streams. The majority of the literature concerning horizontal carrier cooperation is devoted to carrier alliances in which customer requests are exchanged through various techniques. Making use of **order sharing**, carriers can improve their efficiency and profitability because of the following increase in capacity utilization and asset repositioning capabilities and the reduction in total transportation costs [3]. Reviewing this research field reveals that order sharing literature focuses mainly on auction based mechanisms. An interesting alternative, however, currently only scarcely investigated, is that of joint route planning through vehicle routing techniques, to determine

optimal routes for individual trucks transporting shared orders. Finding a solution to this problem is challenging due to a number of factors. Transport demands with varying characteristics are shared and thus need to be assigned to a carrier. Carriers may cooperate only for a limited number of specific requests or may choose full collaboration. Each carrier has its own vehicle depot and a fleet with a limited capacity. Multiple time periods have to be taken into account to provide a good balance for each carrier involved in the collaboration scheme and different orders present different delivery deadlines. Instead of sharing customer requests, carriers can also cooperate horizontally through the **sharing of vehicle capacities**. In this way capital investments may be split among the partners and utilization rates of vehicles may be improved [4]. Solution techniques proposed in current literature focus on mathematical programming to determine cost minimizing service routes when capacity is shared. A third and last research stream in carrier collaboration is that of **profit / cost allocation**. As the goal of a horizontal cooperation is to increase carriers' transport efficiency and collaboration often results in an additional profit, an efficient profit / cost allocation scheme needs to be determined. Solving this problem is essential because the proposed allocation mechanism has an important influence on the long-term sustainability of the cooperation. Reviewing current studies on this topic reveal that it is particularly challenging to create an allocation mechanism that is desirable on a collaborative and individual level. However, cooperative game theory can provide the necessary framework to cope with these issues [5].

Future work will focus on expanding the knowledge on operational carrier cooperation planning through the study of vehicle routing approaches to order sharing, capacity sharing techniques and profit/cost allocation through game theory as these promising topics have not been sufficiently studied yet in current literature.

References

- [1] Cruijssen F., Cools M., Dullaert W. (2007). Horizontal cooperation in logistics: Opportunities and impediments. *Transportation Research Part E: Logistics and Transportation Review*, 43(2), 129-142.
- [2] Cruijssen F., Dullaert W., Fleuren, H. (2007). Horizontal cooperation in Transport and Logistics: A literature review. *Transportation Journal*, 46(3), 22-39.
- [3] Dai, B., Chen, H. (2011). A multi-agent and auction-based framework and approach for carrier collaboration. *Logistics Research*, 3(2-3), 101-120.
- [4] Agarwal, R., Ergun, O. (2010). Network Design and Allocation Mechanisms for Carrier Alliances in Liner Shipping. *Operations Research*, 58(6), 1726-1742.
- [5] Liu, P., Wu, Y., Xu, N. (2010). Allocating collaborative profit in less-than-truckload carrier alliance. *Journal of Service Science and Management*, (3), 143-149.